CLAIMS

1. A Coriolis mass flow meter comprising:

two parallel curved flow tubes having base plates fixedly fitted to them at the points serving as first vibration fulcrums;

an inlet-side manifold branching from an inlet of a fluid being measured to said two flow tubes;

an outlet side manifold for joining fluid flows flowing in said two flow tubes to discharge from a fluid outlet;

a drive unit for causing any one of said flow tubes to resonate with the other flow tube in an opposite phase with each other;

a pair of vibration sensors, disposed at symmetrical positions with respect to the mounting position of said drive unit, for sensing a phase difference proportional to Coriolis force;

a meter body holds connecting ports at both ends and the entire flow meter, and said meter body is mechanically connected to said inlet-side and outlet-side manifolds only at the inlet-side of said inlet-side manifold and at the outlet side of said outlet side manifold, respectively, so that the joint parts between said inlet-side and outlet-side manifolds and said flow tubes that serve as second vibration fulcrums, can be isolated from said meter body and all structures connected thereto.

2. A Coriolis mass flow meter as set forth in Claim 1 wherein a flow path of said inlet side manifold is smoothly curved from the inlet thereof, branching into two flow tubes while continuously reducing the total cross-sectional area of flow paths of said two flow tubes; and flow paths of said outlet-side manifold are smoothly curved from the joint parts thereof with said flow tubes, joining said flow paths while continuously increasing the total cross-sectional area of said flow paths, and leading to a fluid outlet.

3. A Coriolis mass flow meter as set forth in Claim 2 wherein said inlet-side and outlet-side manifolds are formed into curved blocks whose cross-sectional areas continuously increase toward said joint parts with said flow tubes from said fluid inlet or said fluid outlet.

4. A Coriolis mass flow meter as set forth in Claim 1 wherein said meter body has a U-shaped cross section and a box construction having at the upper part thereof a base plate to prevent said meter body from interfering with said vibration fulcrums. reference

5. A Coriolis mass flow meter as set forth in Claim 4 wherein said meter body has a U-shaped case having a circular arc-shaped outer circumferential shape and integrally connected thereto.

6. A Coriolis mass flow meter as set forth in Claim 1 wherein said drive unit and said

vibration sensors are disposed between said two flow tubes in such a manner as to be aligned with the central axes of said two flow tubes.

7. A Coriolis mass flow meter as set forth in Claim 1 wherein the wiring from said drive unit and said vibration sensors to the outside is provided at the center axis on the inlet and outlet sides of said flow tubes, using flexible printed circuit boards bent symmetrically from both sides of said two flow tubes, in such a manner that masses and stresses added to said two flow tubes are symmetrical.

8. A Coriolis mass flow meter as set forth in Claim 1 wherein said vibration sensors are disposed at nodes of the secondary vibration mode at the proximal parts each on the inlet and outlet sides that serve as vibration beams.

9. A Coriolis mass flow meter comprising:
two parallel flow tubes of a curved tube type having base plates fixedly fitted to them at the points serving as vibration fulcrums;
a drive unit disposed at the central part of said flow tubes for causing any one of said flow tubes to resonate with the other tube in a phase opposite to each other;
a pair of vibration sensors disposed at symmetrical positions with respect to the mounting position of said drive unit for sensing a phase difference proportional to Coriolis force; said drive unit and a pair of said vibration sensors each being formed by a coil and a magnet; said drive unit coil is fitted to any one of said flow tubes and said drive unit magnet is fitted to the other of said flow tubes, and magnets of said vibration sensors are fitted to said any one of said flow tubes and coils of said vibration sensors are fitted to the other flow tube.

10. A Coriolis mass flow meter as set forth in Claim 9 wherein a support post facing at the end thereof said drive unit provided at the central part of said flow tubes and having wires for electrical connection passed therein is provided; a first flexible printed circuit board extending from the end surface of said support post to the one flow tube is connected to said drive unit coil, and a second flexible printed circuit board extending from the end surface of said support post to the other flow tube is connected to wires extended from coils of said vibration sensors along the surface of said flow tubes in such a manner that said flexible printed circuit boards are bent at the central part of said flow tubes almost symmetrically with respect to the vibration center of each flow tube.

11. A Coriolis mass flow meter comprising:
an inlet manifold having an inlet side with a single port, said inlet manifold having an outlet side first and second ports;
a first flow tube having an upstream end connected to said first port of said inlet manifold;
a second flow tube having an upstream end connected to said second port of said inlet

manifold;

an outlet manifold having an inlet side with a first and second ports, said first port of said outlet manifold being connected to a downstream end of said first flow tube, said second port of said outlet manifold being connected to a downstream end of said second flow tube, said outlet manifold having an outlet side with a single port;

a drive unit vibrateable of said first and second flow tubes in opposite phase to each other;

a pair of vibration sensors for sensing a phase difference between said first and second flow tubes caused by a Coriolis force from fluid flowing through said first and second flow tubes;

a base plate connected to said first and second flow tubes and forming first vibration fulcrums, a connection between said first and second ports of said inlet manifold and a connection between said first and second ports of said outlet manifold form second vibration fulcrums;

a meter body connected to said inlet side of said inlet manifold and connected to said outlet side of said outlet manifold, said meter body being spaced from said second vibration fulcrums.

12. A meter in accordance with claim 11, wherein:

said drive unit vibrates said first and second flow tubes toward and away from each other.

13. A meter in accordance with claim 11, wherein:

said meter body is spaced from said first and second ports of said inlet and outlet manifold

14. A meter in accordance with claim 11, wherein:

said first and second ports of said inlet manifold are spaced from each other;

said first and second ports of said outlet manifold are spaced from each other.

15. A meter in accordance with claim 11, wherein:

said drive unit includes a magnet connected to said first flow tube and includes a coil connected to said second flow tube;

each of said sensors include a magnet connected to said second flow tube and include a coil connected to said first flow tube.

16. A meter in accordance with claim 15, wherein:

said first and second flow tubes have a U shape;

a support post is arranged on said meter body and extends along a center of said U shape;

said drive unit is arranged in a center of said U shape;

a first flexible circuit board extends from said support post to said first flow tube;

a second flexible circuit board extends from said support post to said second flow tube, said first and second flexible circuit boards curve substantially symmetrically.

17. A meter in accordance with claim 11, wherein:

said vibration sensors are arranged at secondary vibration nodes of said first and second flow tubes.

18. A meter in accordance with claim 11, wherein:

said inlet and outlet manifolds have a shape to preclude the manifolds from having a particular natural frequency.

19. A meter in accordance with claim 11, wherein:
said inlet and outlet manifolds have a continuously increasing shape without a particular natural frequency.